WTCI-455-P

April 4, 1966

Messrs. Levy, Mills, Soffer, Tessler

From: R. M. MONTI (Ext. 7916 — Room 300)

Attached is a copy of cost comparisons and recommendations for sprayed fireproofing, received from Tishman under date of 3/30/66.

Please review and advise me of any comments you may have.

R.M.M.

Enc.
Att.

4/21/66

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Send Tracer to Tessler

"Any Comments?"

No Comment

Mutney

Lucie

File

PLAINTIFF'S EXHIBIT PX-449

TISHMAN REALTY & CONSTRUCTION CO., INC.
666 FIFTH AVENUE
NEW YORK, N.Y. 10019

OWNERS AND BUILDERS SINCE 1898

JUDSON 2-6700

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THE PORT OF NEW YORK AUTHORITY
RECEIVED
APR 1 1966
WORLD TRADE DEPARTMENT
WORLD TRADE CENTER
PLANNING DIVISION

MARCH 30, 1966

PORT OF NEW YORK AUTHORITY
111 EIGHTH AVENUE
NEW YORK, NEW YORK 10011

ATTENTION: MR. R. M. MONTI, RES. ENGINEER - WORLD TRADE CENTER

RE: FIREPROOFING COST COMPARISON
WORLD TRADE CENTER

DEAR RAY:

WE ARE TRANSMITTING HEREWITH OUR COST COMPARISON AND RECOMMENDATIONS FOR SPRAYED FIREPROOFING. THIS ANALYSIS COMPARES THE COSTS AND MERITS OF VONCO 2, CAFCO TYPE D, SPRAY-CRAFT, FIRECODE V AND MONOCOAT SPRAY MATERIALS. WE HAVE SELECTED FOR COMPARISON, ONLY THOSE SYSTEMS FOR WHICH UNDERWRITERS' LABORATORIES INC. AND/OR NEW YORK BOARD OF STANDARDS AND APPEALS APPROVALS ALREADY EXIST OR ARE IMMINENTLY EXPECTED.

THE ANALYSIS SHOWS AUTHORITY, STRUCTURAL MEMBER SIZE AND FUNCTIONAL FIREPROOFING THICKNESS REQUIRED, FIRE RATING IN HOURS, AS WELL AS COST PER SQUARE FOOT FOR MATERIAL AND LABOR AT THE INDICATED THICKNESS. WE HAVE ALSO INTERJECTED BY NOTE, INFORMATION WHICH WE FEEL IS PERTINENT TO PERFORMANCE AS WELL AS POSSIBLE, HIDDEN ECONOMIES OR EXPENSES.

VERY TRULY YOURS,

TISHMAN REALTY & CONSTRUCTION CO., INC.

JAMES R. ENDLER
ASSISTANT VICE PRESIDENT

ENCL.
DU

LABOR AND MATERIAL COSTS REFLECT SPRAYED SQUARE FOOT CONTACT AREA, INCLUDING OVERHEAD AND PROFIT AND N.Y.C. SALES TAX FOR THE INDICATED THICKNESS AND ASSUME LARGE UNCLUTTERED AREAS WHERE FULL PRODUCTION IS ASSURED, BUT DOES NOT PROVIDE FOR EXCESSIVE CLEAN-UP OR SCAFFOLDING. THESE COSTS SHOULD NOT BE USED FOR SPRAY REQUIREMENTS BETWEEN EXTERIOR COLUMN OR SPANDRELS AND THE CURTAIN WALL, SINCE ACTI PRODUCTION CANNOT BE DETERMINED.

MATERIAL DESCRIPTION	AUTHORITY (U.L.I.) (B.S.A.)	SIZE OF MEMBER TESTED	INCHES REQ.	FIRE RATING IN HOURS	MAT. $/SQ.FT.	LABOR $/SQ.FT.	TOTAL $/SQ.F
"VONCO 2 AND 4 W"	ULI-48-3	8"BEAM	9/16"	5	.225*	.057**	.282
MAGNESIUM OXYCHLORIDE SPRAY MATERIAL AS MANUFACTURED BY THE MD CORP. OF 101 EMPIRE BUILDING, SPRINGFIELD, MISSOURI.	ULI-29-4	10WF49 COL.	2 5/16"	4	.925*	.210	1.135
	ULI-2-I½	10WF49 COL.	1"	1½	.400*	.091	.491
	UNLISTED***	10WF49 COL.	1 3/4"	4	.700*	.159	.859
	UNLISTED***	10WF49 COL.	1½"	3	.600*	.136	.736
	UNLISTED***	10WF49 COL.	1¼"	2	.500*	.113	.613

* MATERIAL COSTS MAY BE REDUCED FROM .05 TO .06 PER BOARD FT. IF A VONCO PLANT IS LOCATED IN THE EAST AS INDICATED BY MR. HARVEY DAVIS OF THE MD CORP.

** LABOR COSTS WERE ASSUMED THE SAME AS THOSE USED FOR SPRAYED CEMENTATIOUS MATERIALS SINCE NO ACTUAL APPLICATION COSTS ARE AVAILABLE FOR VONCO.

*** ULI FIRE TESTS WERE CONDUCTED AND APPROVED, BUT WERE NOT INCLUDED IN THE 1966 ULI BUILDING MATERIALS' LIST OR THE FEBRUARY BI-MONTHLY SUPPLEMENT.

NOTE No.1 - THIS COMPANY HAS ALSO CONDUCTED THE FOLLOWING ULI FIRE TESTS ON A 10WF49 COLUMN. THESE APPROVALS ARE NOT LISTED TO DATE.
A) ½" THICKNESS FAILED @ 50 MINUTES
B) 1" THICKNESS FAILED @ 1 HOUR AND 55 MINUTES
C) 2¼" THICKNESS FAILED @ 6 HOURS AND 14 MINUTES

NOTE No.2 - THIS MATERIAL IS REPORTED ACCEPTABLE FOR EXTERIOR APPLICATION AT OUTSIDE TEMPERATURES OF 0°F.

CAFCO TYPE "D"	ULI-86-3 195-65-SM	8" BEAM	½"	4	.075	.041	.116
CRYSOTILE ASBESTOS AND MINERAL FIBER FIREPROOFING AS MANUFACTURED BY THE UNITED STATES MINERAL PRODUCTS CO., STANHOPE, N.J. AND CALLED "BLAZE SHIELD".	ULI-19-3 195-65-SM	14WF228 COL.	1 1/8"	3	.169	.092	.261
	ULI-20-4 195-65-SM	14WF228 COL.	1 3/4"	4	.262	.144	.406

NOTE No.1 - AS PER CAFCO FILE NO. C-409, FIELD PAINTING OF STRUCTURAL STEEL MAY BE ELIMINATED WHEN "CAFCO" IS APPLIED DIRECT.

NOTE No.2 - NO TAMPING OR ADHESIVE IS REQUIRED.

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NOTE No.3 - MAY BE SPRAYED BY POLE-FIBER-GUN WHICH SHOULD EFFECT SCAFFOLDING COSTS.

MATERIAL DESCRIPTION	AUTHORITY (U.L.I.) (B.S.A.)	SIZE OF MEMBER TESTED	INCHES REQ.	FIRE RATING IN HOURS	MAT. $/SQ.FT.	LABOR $/SQ.FT.	TOTAL $/SQ.F
SPRAY CRAFT ASBESTOS FIBER MANUFACTURED BY THE SMITH & KANZLER CORP., 1414 EAST LINDEN AVENUE LINDEN, N.J.	ULI-203-2 502-53-SM	10" BEAM	½"	3	.075	.041	.116
	ULI-81-3	10WF29 BEAM	7/8"	4	.131	.072	.203
	ULI-76-3 502-53-SM	10" BEAM	3/4"	4	.113	.062	.175
	ULI-25-5	8" BEAM	1 7/8"	5	.281	.154	.435 X
	R2923-12 (OBSOLETE)	COLUMN	3"	4	.450	.246	.696
	UNLISTED*	14WF228 COL.	1 3/4"	5	.263	.144	.407
	UNLISTED*	14WF228 COL.	1 3/16"	4	.178	.097	.275
	UNLISTED*	14WF228 COL.	7/8"	3	.131	.072	.203

* ULI FIRE TESTS WERE CONDUCTED AND APPROVED BUT WERE NOT INCLUDED IN THE 1966 ULI BUILDING MATERIALS LIST OR THE FEBRUARY BI-MONTHLY SUPPLEMENT.

NOTE NO. 1 - NO TAMPING OR ADHESIVE IS REQUIRED.

NOTE NO. 2 - MAY BE APPLIED WITH POLE-FIBER-GUN, WHICH SHOULD EFFECT SCAFFOLDING COSTS.

FIRE CODE "D" OR "V" SPRAY CEMENTATIOUS AS MANUFACTURED BY THE UNITED STATES GYPSUM CO., CHICAGO, ILL.	ULI-37-5	8"BEAM ONLY	1¼"	5	.108	.119	.227
	ULI-22-3	8"BEAM	1¼"	4	.108	.119	.227
	ULI-24-3	8"BEAM	1½"	4	.124	.136	.260
	ULI-32-3	12"BEAM	1¼"	3	.108	.119	.227
	ULI-67-3	8"BEAM ONLY	1"	3	.077	.091	.168
	ULI-70-3	8"BEAM	1½"	5	.124	.136	.260
	ULI-30-4	10WF49 COL.	2¼"	4	.186	.204	.390
	ULI-13-3	COLUMN	2 1/8"	3	.175	.193	.368
	ULI-23-3	14WF228 COL.	7/8"	3	.072	.079	.151
	ULI-25-3	10WF49 COL.	1 7/8"	3	.154	.170	.324
	ULI-229-2	8 WF BEAM	3/4"	3	.062	.068	.130

	(U.L.I.) (B.S.A.)	MEMBER TESTED	REQ.	RATING IN HOURS	$/SQ.FT.	$/SQ.FT.	$/SQ.F
	ULI-31-4						
	UNLISTED*	10WF228 COL.	1½"	4	.108	.113	.221
	UNLISTED*	10WF228 COL.	1 1/8"	4	.092	.102	.194
	UNLISTED*	10WF228 COL.	13/16"	3	.066	.075	.141

* ULI FIRE TESTS WERE CONDUCTED AND APPROVED BUT WERE NOT INCLUDED IN THE 1966 - ULI BUILDING MATERIALS' LIST OR THE FEBRUARY BI-MONTHLY SUPPLEMENT.

NOTE No. 1 - COSTS INDICATED DO NOT INCLUDE POSSIBLE REQUIRED SCAFFOLDING OR EXCESSIVE CLEAN-UP AND/OR PROTECTION FOR OVERSPRAY.

NOTE No. 2 - MATERIAL COSTS WERE INDICATED BY THE N.Y.C. REPRESENTATIVE OF U.S. GYPSUM CO. (REVISED PRICES).

MONOCOAT	ULI-248-2*	8WF28 BEAM	3/4"	4	.062	.068	.130
CEMENTATIOUS SPRAY FIREPROOFING AS MANUFACTURED BY THE ZONOLITE DIVISION OF THE W.R. GRACE & CO. CHICAGO, ILL.	ULI-23-3**	14WF228 COL.	7/8"	3	.070	.079	.149
	ULI-27-4**	14WF228 COL.	1½"	4	.108	.119	.227

* ULI FIRE TESTS WERE CONDUCTED AND APPROVED BUT
** WERE NOT INCLUDED IN THE 1966 ULI BUILDING MATERIALS' LIST OR THE FEBRUARY BI-MONTHLY SUPPLEMENT. (3/4" THICKNESS FAILED @ 4 HOURS AND 10 MINUTES.)

NOTE No. 1 - COSTS INDICATED DO NOT INCLUDE POSSIBLE REQUIRED SCAFFOLDING OR EXCESSIVE CLEAN-UP AND/OR PROTECTION FOR OVERSPRAY.

NOTE No. 2 - MATERIAL COSTS WERE INDICATED BY THE W.R. GRACE & CO.

WORLD TRADE CENTER - FIREPROOFING ANALYSIS

RECOMMENDATIONS

PRESENTLY, IT APPEARS THAT THE SPRAYED FIBER MATERIALS (CAFCO AND SPRAY CRAFT) ENJOY A SLIGHTLY MORE ECONOMICAL APPLIED COST PER SQUARE FOOT THAN THE SPRAYED CEMENTITIOUS (FIRECODE V AND MONOCOAT) MATERIALS BUT NOT ENOUGH TO PRECLUDE KEEPING BOTH IN COMPETITION UNTIL A FINAL BUY IS MADE. NOTE THAT THE FIBER SUPPLIERS HAVE NOT CONDUCTED AS EXTENSIVE A FIRE TESTING PROGRAM AS HAVE THE CEMENTITIOUS MATERIAL MANUFACTURERS. SINCE MORE DATA IS AVAILABLE IN THE LATTER INSTANCE, MORE ACCURATE INTERPOLATION IS POSSIBLE HERE WITHOUT EXPENSIVE ADDITIONAL TESTING.

THE REMOVAL OF BOTH THE TAMPING AND ADHESIVE REQUIREMENTS (BY ACTUAL U.L.I. AUTHORITY) FROM THE FIBER APPLICATIONS, THE APPARENT ABILITY TO SPRAY FIBER WITH ACCURACY FROM THE FLOOR USING THE NEWLY DEVELOPED POLE-FIBER-GUN AND THE RELATIVE EASE OF CLEAN-UP WITHOUT SCRAPING OF OVER SPRAYED MATERIAL, GENERALLY CONTRIBUTES TO THE EDGE IN ECONOMY OF THE FIBER MATERIALS.

THE POSSIBLE REQUIREMENT (ASSUMING THAT AN EXTERIOR GYPSUM BOARD ASSEMBLY PROVES ITSELF) OF CONFINED SPRAYING BETWEEN THE CURTAIN WALL AND EXTERIOR BOX COLUMNS AS WELL AS BETWEEN THE CURTAIN WALL AND EXTERIOR SPANDREL MEMBERS, COULD GIVE THE FIBER MATERIAL AN ADDED ADVANTAGE OVER CEMENTITIOUS, SINCE FIBER EQUIPMENT APPEARS MORE VERSATILE AND EASILY ADAPTABLE TO FAN SPRAYS, NOZZLE MIXING OR SLURRY MIXING (GROUT), SIMPLY BY CHANGING EXISTING SPRAY HEADS OR ADAPTING NEW HEAD CONFIGURATIONS IF EXISTING EQUIPMENT CANNOT BE SATISFACTORILY CONTROLLED.

THE ABILITY OF THE CEMENTITIOUS MATERIAL TO HARDEN OR CRUST AFTER APPLICATION IS A PLUS FOR THIS MATERIAL SINCE DUCT WORK GENERALLY IS SCHEDULED FOR INSTALLATION (BETWEEN TRUSSES) AFTER THE FIREPROOFING OF STEEL, WITH RESULTING DAMAGE TO FIREPROOFING BEING MINIMIZED. MATERIAL COSTS HAVE BEEN DROPPING AND MAY NOT HAVE REACHED BOTTOM.

IT IS RECOMMENDED THAT BOTH SPRAYED FIBER AND SPRAYED CEMENTITIOUS SUBCONTRACTORS BE PLACED IN A COMPETITION WITH EACH OTHER WITH INSTRUCTIONS FOR LOGICAL INTERPOLATION OF REQUIRED THICKNESS OF THEIR RESPECTIVE MATERIALS BASED ON ACTUAL OR UNPUBLISHED UNDERWRITERS' LABORATORIES APPROVALS.

WE ARE IN THE PROCESS OF EVALUATING THE ECONOMICS OF VONCO MAGNESIUM SPRAY VERSUS A SPECIAL WATERPROOFED LAMINATED ASSEMBLY OF GYPSUM BOARD SHEETS FOR THE EXTERIOR OF THE COLUMNS AND SPANDRELS ONLY (WHERE MOISTURE OR TEMPERATURE PRECLUDES OTHER MATERIALS, IN OUR OPINION, WITHOUT EXCESSIVE RE-WORK).

VONCO IS TOO COSTLY FOR FURTHER CONSIDERATION FOR INTERIOR FIREPROOFING APPLICATION.

WHEN THIS ANALYSIS IS COMPLETE, WE WILL RECOMMEND THE MOST ECONOMICAL APPROACH TO THE PROJECT'S EXTERIOR FIREPROOFING REQUIREMENTS. AT THIS TIME, THERE APPEARS JUSTIFICATION TO PURSUE THE INVESTIGATION OF THIS PREFABRICATED LAMINATED ASSEMBLY OF EITHER THE STANDARD 5/8" FIRECODE GYPSUM BOARD OR A SPECIAL BOARD MADE OF FIRECODE V MATERIAL WHICH CONCEIVABLY WILL PERMIT A 4 HOUR RATING WITH A SINGLE 1 1/8" THICK BOARD (U.L.I. 31-4 REVISED) FOR APPLICATION TO THE EXTERIOR FACE OF THE EXTERIOR BOX COLUMNS, PERMITTING THE ERECTION OF CURTAIN WALL AND THE CLOSING IN OF THE TOWER STRUCTURE PRIOR TO APPLICATION OF THE INTERIOR SPRAYED

FIREPROOFING. IF THE BUILDING CAN BE ENCLOSED EARLY IN THE CONSTRUCTION CYCLE, INTERIOR FIREPROOFING WITH EITHER FIBER OR CEMENTITIOUS MATERIAL WILL BE MORE EFFICIENT AND THUS MORE ECONOMICAL.

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SUMMARY OF MATERIALS AND APPLICATIONS SURVEY FOR TRUSS FIREPROOFING

MATERIAL	COMPANY	TYPE MATERIAL	APPLICATION	DATE OF LAST CONTACT 11-19-65	CONTACT MAN	EST COST /S.F.	REMARKS
MONO-KOTE	TONOLITE CO.	CEMENT-PLASTER GYP.-PERLITE PLASTER	SPRAY	10-8-65	S. CLIPLA	.55 .50	TODAY APPLICATION BEING RECEIVED FROM $ MAY BE LOWER.
LIMPET	ARMSTRONG CO.	ASBESTOS-FIBER	SPRAY			.75	READILY AVAILABLE
BLAZE-CRETE BLAZE-SHIELD	COLUMBIA F.P. CO. CAFCO	MINERAL-FIBER do	SPRAY do			.75 do	READILY AVAILABLE do
MATERIAL 'X'	U.S. RUBBER CO.	SOLID SHEET PLASTIC (?)	MOLDED-MOLDED	12-19-65	J.N. LAMBER	ALL RE SENSITIVE	THEY ARE STILL TESTING (WITH VENICO) WE HAVE DIRECT COMMUNICATION
VONCO No 4	VONCO CO.	CEMENT-PLASTER MAS.-GYP.-PLASTER	SPRAY	12-8-65	JACK HILL	.95 .38	LOOKS LIKE VONCO APPLICATOR FOR PRE-FIRE COMPANY HAS LIMITED FABRICATION FACIL
ALDI-CLAD	ALDI MFG. CO.	INTUMESCENT PAINT	SPRAY	11-30-65	D. LAWALLER	.75	CAN PAINT OVER 2 HR. RATING
FLAME-CRETE	OCEAN CHEM. CO.	RETARDENT PAINT	SPRAY OR BRUSH	12-1-65	D.J. MOREY	EXPENSIVE	NO APPLICATOR AVAILABLE FOR JOB REQUIRES
FIRE-CODE V	U.S. GYPSUM CO.	CEMENT-PLASTER GYP. VERMC.	SPRAY OR CASTING	12-16-65	JOE BELOW	ALL RE SENSITIVE	THEY ARE TESTING VERSUS APPLICATING METHODS BEING FABRICATED FOR TESTS.
TIPER-FUL	DUPONT CO.	FIBROUS POTASSIUM TITORATE	SPRAY				TRYING TO MAKE SENSIBLE COMMUNICATION FOR NEW ONLY.
MATERIAL 'E'	UNION CARBIDE CO.	PLASTIC FOAM FILM	DIP	12-2-65	ROGER DAVIS		THEIR INVOLVEMENT IS SOLELY DUE TO THEIR INTEREST IN PROJECT.
MAZINITE	JOHNS-MANVILLE	SOLID SHEET	WRAP	11-2-65	JOE MOREY	$1.00	FOR COLUMN APPLICATION ONLY.

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... AS TAKEN FROM RESPECTIVE COMPANY CATALOGS

Product	Asser-Sprayed Insulation Co.	Air-O-Therm Application Co.	Armstrong Contract & Supply	Asbestospray Corporation	Cambia Acoustics & Fireproofing	National Gypsum Co.	Permalite	Sprayon Insul. & Acoustics Inc.	U.S. Gypsum	Zonolite Company	V. Corp.
Sweets Catalog Item	"Sprayocraft" 10a/As	Jet-Sulation Type 400 10a/Al	"Limpet" 10a/Am	"Asbestospray" 11a/Ae	"Nico" Dia Shield 11/Co	"Gold Bond Sprayolite" 11a/No	Permalite Plaster Aggr. 12b/Per (2)	"SprayDon" 11a/Sp	Red Top Firecode 11a/Ua	Zonolite MonoKote 12b/Zo	Vmc
Fire Resistance Rating Hours 1. Ceiling	3 hr. @ 1/2 (1)	2 hr. @ 1"	4 hr. @ 1/2 (1)	4 hr. @ 5/8 (1)	3 hr. @ 7/16 (1)	3 1/2 hr. @ 5/8" (1)	5 hr. @ 1" (1) (3)	3 hr. @ 3/4 (1)	3 hr. @ 3/4-1"	2 hr. @ 5/8 (1)	3 hr.
Thickness 2. Beam Authority	5 hr. @ 1 7/8" U. L.	2 hr. @ 2 1/2" U.L. Des. 19	4 hr. @ 1 3/4" U.L.	4 hr. @ 1 1/16" U.L.	4 hr. @ 1" U.C.	4 hr. @ 1" O.S.U.	6 hr. @ 1 1/2 U.L.	3 hr. @ 1" U.L.	4 hr. @ 2 1/2" U.L.	5 hr. @ 1 1/2" U.L.	5 hr. U.L.
Thermal Conductivity K-Factor Thickness	0.261 1"	0.259 1"	0.223 1"	0.26 1"	0. 3/	0.83 5/8"	1.12	0.24	.80		0.05 1"
U-Factor				0.22 @ 1"						0.41 @ 1"	0.066
Acoustical Value (N.R.C.)	0.75	0.90	0.75 @ 1"	0.85 @ 1"	0.5 @ 7/8"				0.45	0.55	
Applied Dry Density (wt. p.c.f.)	1 1/4# @ 1/2"		10.5 - 12#			3# p.c.f.	3.96# p.c.f.	3# p.c.f.	3# p.c.f.	2# p.c.f. @ 1"	3# p.
Color	To Suit	Off-White	White		White (Off)		White	White		Off-White	Off-W
Number of Installation Steps	1	1 or more	1 or more	1		1	2 to 3	1	1	2 or more	1
Type of Material	Asbestos & Mineral Wool	Stone Fibre	Asbestos Fibre	Asbestos Fibre	Asbestos Fibre	Mineral Wool	Perlite	Mineral Fibre	Vermiculite	Vermiculite	Vermi (Gluf
Material Cost p.c.f.											
Installation Cost											
Is Adhesive Necessary?	Yes	Yes	No	Yes	No	No	No	Yes	No	No	No
Is Sealer Necessary?	Yes	Yes	No	Yes	No	No	Yes Gypsum Plaster	Yes	No	No	No

(1) Cellular floor design that is approximately 55% dependent on "K" Factor to obtain fire rating.

(2) This is an additive to fibred gypsum plaster. 3 cu. ft. Permalite to 100 gypsum plast

(3) Boxed Beam--No designs approved showing contour application.

js/10-7-63
KIIA